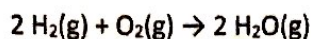


FR Practice #2 (2002B #2, 10 points)

2. A rigid 8.20 L flask contains a mixture of 2.50 moles of H_2 , 0.500 mole of O_2 , and sufficient Ar so that the partial pressure of Ar in the flask is 2.00 atm. The temperature is 127°C .
- Calculate the total pressure in the flask. (3 points)
 - Calculate the mole fraction of H_2 in the flask. (2 points)
 - Calculate the density (in g L^{-1}) of the mixture in the flask. (2 points)

The mixture is ignited by a spark, and the reaction represented below occurs until one of the reactants is entirely consumed.



- Give the mole fraction of all species present in the flask at the end of the reaction. (3 points)

$$(3 \text{ pt}) \text{ (a) } P_{\text{H}_2} = \frac{n_{\text{H}_2} RT}{V} = \frac{(2.50 \text{ mol})(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(400. \text{K})}{8.20 \text{ L}} = 10.0 \text{ atm} \quad (1 \text{ pt})$$

$$P_{\text{O}_2} = \frac{n_{\text{O}_2} RT}{V} = \frac{(0.500 \text{ mol})(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(400. \text{K})}{8.20 \text{ L}} = 2.00 \text{ atm} \quad (1 \text{ pt})$$

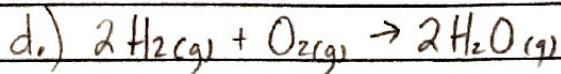
$$P_{\text{tot}} = P_{\text{H}_2} + P_{\text{O}_2} + P_{\text{Ar}} = 10.0 + 2.0 + 2.0 = \boxed{14.0 \text{ atm}}$$

$$(2 \text{ pt}) \text{ (b) } \text{mol Ar} = \frac{PV}{RT} = \frac{(2.00 \text{ atm})(8.20 \text{ L})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(400. \text{K})} = 0.500 \text{ mol Ar} \quad (1 \text{ pt})$$

$$X_{\text{H}_2} = \frac{2.50 \text{ mol H}_2}{2.50 \text{ mol H}_2 + 0.500 \text{ mol O}_2 + 0.500 \text{ mol Ar}} = \frac{2.50 \text{ mol}}{3.50 \text{ mol}} = \boxed{0.714}$$

$$(2 \text{ pt}) \text{ (c) } \left. \begin{array}{l} 2.50 \text{ mol H}_2 \times \frac{2.016 \text{ g H}_2}{1 \text{ mol H}_2} = 5.04 \text{ g H}_2 \\ 0.500 \text{ mol O}_2 \times \frac{32.0 \text{ g O}_2}{1 \text{ mol O}_2} = 16.0 \text{ g O}_2 \\ 0.500 \text{ mol Ar} \times \frac{40.0 \text{ g Ar}}{1 \text{ mol Ar}} = 20.0 \text{ g Ar} \end{array} \right\} \text{total mass} = 5.04 + 16.0 + 20.0 = 41.0 \text{ g} \quad (1 \text{ pt})$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{41.0 \text{ g}}{8.20 \text{ L}} = \boxed{5.00 \text{ g/L}} \quad (1 \text{ pt})$$



$$\begin{array}{ccc} 2.50 & 0.500 & 0 \end{array}$$

$$\begin{array}{ccc} -1.00 & -0.500 & +1.00 \end{array}$$

$$\begin{array}{ccc} 1.50 & \emptyset & 1.00 \end{array} \Rightarrow \text{total moles} = 1.50 \text{ mol} + 1.00 \text{ mol} + 0.500 \text{ mol}$$

after rxn H₂ H₂O Ar

$$= 3.00 \text{ mol total (1 pt)}$$

$$X_{\text{H}_2} = \frac{1.50 \text{ mol H}_2}{3.00 \text{ mol}} = \boxed{0.500}$$

$$X_{\text{Ar}} = \frac{0.500 \text{ mol Ar}}{3.00} = \boxed{0.167}$$

$$X_{\text{H}_2\text{O}} = \frac{1.00 \text{ mol H}_2\text{O}}{3.00} = \boxed{0.333}$$

} 1 pt for any two